

- If  $a = \cos (2012\pi)$ ,  $b = \sec (2013\pi)$  and  $c = \tan (2014\pi)$  then  
 (A)  $a < b < c$  (B)  $b < c < a$  (C)  $c < b < a$  (D)  $a = b < c$
- An equilateral triangle has side length 8 . The area of the region containing all points outside the triangle but not more than 3 units from a point on the triangle is :  
 (A)  $9(8 + \pi)$  (B)  $8(9 + \pi)$  (C)  $9\left(8 + \frac{\pi}{2}\right)$  (D)  $8\left(9 + \frac{\pi}{2}\right)$
- If  $(\sec \alpha + \tan \alpha)(\sec \beta + \tan \beta)(\sec \gamma + \tan \gamma) = \tan \alpha \tan \beta \tan \gamma$  then value of  $(\sec \alpha - \tan \alpha)(\sec \beta - \tan \beta)(\sec \gamma - \tan \gamma)$  equal to  
 (A)  $\tan \alpha \tan \beta \tan \gamma$  (B)  $\cot \alpha \cot \beta \cot \gamma$   
 (C)  $\tan \alpha + \tan \beta + \tan \gamma$  (D)  $\cot \alpha + \cot \beta + \cot \gamma$
- If  $\cos \theta_1 + \cos \theta_2 + \cos \theta_3 = -3$ , where  $\theta_1, \theta_2, \theta_3 \in [0, 2\pi]$  then value of  $\sin \frac{\theta_1}{2} + \sin \frac{\theta_2}{2} + \sin \frac{\theta_3}{2}$  is  
 (A) 0 (B) 1 (C) 3 (D) 2
- The value of  $\log_{(\sin^2 x + \cos^4 x + 2)} (\cos^2 x + \sin^4 x + 2)$  is equal to  
 (A) 1 (B) -1 (C) 0 (D) 2
- Which of the following is possible?  
 (A)  $\cos \theta = \frac{\pi}{3}$  (B)  $\sin \theta = x + \frac{1}{x} (x \neq 0)$   
 (C)  $\operatorname{cosec} \theta = -\frac{3}{5}$  (D)  $\tan \theta = -12121$
- There is a formula that says that  

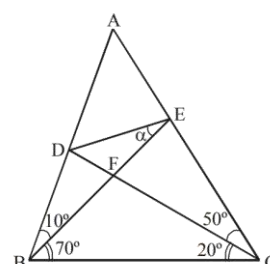
$$\sin 7x = A \sin^7 x + B \sin^6 x + C \sin^5 x + D \sin^4 x + E \sin^3 x + F \sin^2 x + G \sin x + H.$$
 The value of the sum  $(A + B + C + D + E + F + G + H)$ , is  
 (A) 0 (B) 1 (C) -1 (D) not possible to determine
- In the diagram (not drawn to scale),  $\angle ABE = 10^\circ$ ;  $\angle EBC = 70^\circ$ ;  $\angle ACD = 50^\circ$ ;  $\angle DCB = 20^\circ$ ;  $\angle DEF = \alpha$ . Then the value of  $\tan \alpha$  is equal to

(A)  $\frac{\tan 10^\circ \tan 20^\circ}{\tan 50^\circ}$

(B)  $\frac{\tan 10^\circ \tan 20^\circ}{\tan 70^\circ}$

(C)  $\frac{\tan 10^\circ \tan 50^\circ}{\tan 70^\circ}$

(D)  $\frac{\tan 20^\circ \tan 50^\circ}{\tan 70^\circ}$



(Mathematic)

COMPOUND ANGLE

9. The value of  $\tan^2 \frac{\pi}{3} + 4\cos^2 \frac{\pi}{4} + 3\sec^2 \frac{\pi}{6} + \cot^2 \frac{\pi}{2}$  is  
 (A) 9 (B)  $\frac{43}{3}$  (C)  $\frac{16}{3}$  (D) not defined
10. If  $\theta$  is the each interior angle of a regular dodecagon then the value of  $\sin \theta + \cos \theta + \tan \theta + \cot \theta + \sec \theta + \operatorname{cosec} \theta$ , is  
 (A) positive (B) negative and less than  $(-1)$ .  
 (C) zero (D) negative and less than  $(-2)$ .
11. Let  $x = (2 - \sec^2 181^\circ)(2 - \sec^2 182^\circ)(2 - \sec^2 183^\circ) \dots (2 - \sec^2 269^\circ)$ , then  $x$  is  
 (A) positive (B) negative (C\*) non positive (D\*) non negative



1. If  $2\sin x = \sin y$  and  $2\cos x = 3\cos y$  where  $x, y \in \left(0, \frac{\pi}{2}\right)$  then the value of  $\tan(x + y)$  is equal to  
 (A)  $\sqrt{15}$  (B)  $\sqrt{17}$  (C)  $\sqrt{13}$  (D)  $\sqrt{14}$
2. Value of expression  $\frac{\sin 3\theta + \sin 5\theta + \sin 7\theta + \sin 9\theta}{\cos 3\theta + \cos 5\theta + \cos 7\theta + \cos 9\theta}$ , where  $\theta = \frac{\pi}{18}$   
 (A)  $\frac{1}{3}$  (B) 1 (C)  $\sqrt{3}$  (D) None of these
3. The expression  $\frac{(1+\tan 37^\circ)(1+\tan 8^\circ)(1+\tan 15^\circ)(1+\tan 30^\circ)}{(1+\tan 2^\circ)(1+\tan 43^\circ)}$  reduces to  
 (A)  $2\tan 45^\circ$  (B) 4 (C) 8 (D)  $6\cot 45^\circ$
4. If  $P + Q = \frac{7\pi}{6}$ , then the value of  $(\sqrt{3} + \tan P)(\sqrt{3} + \tan Q)$  is equal to  
 (A) 1 (B) 0 (C) 2 (D) 4
5. The smallest positive value of  $x$  (in degrees) for which  

$$\tan x = \frac{\cos 5^\circ \cos 20^\circ + \cos 35^\circ \cos 50^\circ - \sin 5^\circ \sin 20^\circ - \sin 35^\circ \sin 50^\circ}{\sin 5^\circ \cos 20^\circ - \sin 35^\circ \cos 50^\circ + \cos 5^\circ \sin 20^\circ - \cos 35^\circ \sin 50^\circ}$$
 is equal to  
 (A)  $30^\circ$  (B)  $60^\circ$  (C)  $75^\circ$  (D)  $120^\circ$
6. If  $s = \cos^2 \alpha + \cos^2 \beta$ , then the value of  $\cos(\alpha + \beta)\cos(\alpha - \beta)$  in terms of 's', is  
 (A)  $s - 1$  (B)  $\frac{s-1}{s}$  (C)  $s^2$  (D)  $1 - s$
7. The smallest positive value of  $x$  (in degrees) satisfying the equation  $\frac{\sin x - \sin 7x}{\cos 7x - \cos x} = \tan 6x$ , is  
 (A)  $9^\circ$  (B)  $12^\circ$  (C)  $18^\circ$  (D)  $20^\circ$
8. The exact value of  $\cos^2 57^\circ + \cos^2 63^\circ + \cos 57^\circ \cos 63^\circ$  is  
 (A) 1 (B)  $\frac{1}{4}$  (C)  $\frac{1}{2}$  (D)  $\frac{3}{4}$
9. If  $\ln e^{(2\cos^2 x - 1)} = \cos x$ , for  $0 < x \leq \pi$ , then the value of  $x$ , is  
 (A) 0 (B)  $\frac{5\pi}{6}$  (C)  $\frac{\pi}{6}$  (D)  $\frac{2\pi}{3}$
10. If  $\tan(2a - 3b) \cdot \tan(4b - a) = 1$ , where  $a, b \in \left(0, \frac{\pi}{2}\right)$  then the value of  $\tan\left(\frac{a+b}{6}\right)$  is  
 (A)  $\frac{2\sqrt{3}-1}{4\sqrt{3}}$  (B)  $\frac{4-2\sqrt{3}}{2\sqrt{3}}$  (C)  $\frac{2\sqrt{3}-3}{\sqrt{3}}$  (D)  $\frac{2\sqrt{3}-3}{4\sqrt{3}}$

1. If  $\tan \frac{A}{2} = r$ , then the value of  $(\sec A + \tan A)$  is equal to  
 (A)  $\frac{2+r}{2-r}$  (B)  $\frac{2-r}{2+r}$  (C)  $\frac{1+r}{1-r}$  (D)  $\frac{1-r}{1+r}$
2. The value of expression  
 $E = 3(\sin^4 \theta + \cos^4 \theta) - 2(\sin^6 \theta + \cos^6 \theta) + \frac{\sin(\pi-\alpha)}{\sin \alpha - \cos \alpha \tan \frac{\alpha}{2}} - \cos \alpha$  is  
 (A) 0 (B) 1 (C) 2 (D) -1
3. If  $4\sin \alpha \cos \alpha - 8\sin^3 \alpha \cos \alpha = \frac{\sqrt{3}}{2}$  and  $8\cos^4 \alpha - 8\cos^2 \alpha + 1 = \frac{-1}{2}$ , where  $\alpha \in \left(0, \frac{\pi}{2}\right)$ . Then the value of  $\log_{\cos \frac{\alpha}{2}} \left(\frac{\sin \alpha + \cos \alpha}{\sqrt{2}}\right)$  is equal to  
 (A) 0 (B) 1 (C) 2 (D) 3
4. If  $\tan 51^\circ - 2\tan 12^\circ = \tan x^\circ$  and  $\tan \theta \cdot \tan(60^\circ - \theta) \cdot \tan(60^\circ + \theta) = \tan x^\circ$ , then the minimum positive value of  $\theta$  is equal to  
 (A)  $9^\circ$  (B)  $13^\circ$  (C)  $17^\circ$  (D)  $21^\circ$
5. For  $0 < x < \pi$ , the solution to the equation  $\frac{(2+\cos x)^{-1}}{\left(3+\frac{2}{2+\cos x}\right)} = \frac{2}{19}$  is  $x = \frac{A\pi}{B}$ , where B is a prime number. The value of  $(A + B)$  is  
 (A) 9 (B) 7 (C) 5 (D) 4
6. If  $\cos^4 x$  is expressed in the form  $a\cos(4x) + b\cos(2x) + c$ , where a, b and c are constant then the value of  $(a + b + c)$ , is equal to  
 (A) 1 (B)  $\frac{11}{8}$   
 (C)  $\frac{7}{4}$  (D) 2
7. If  $\frac{\cos 3\alpha}{\cos \alpha} = \frac{1}{3}$ ,  $0 < \alpha < \frac{\pi}{2}$  then  $\frac{\sin 3\alpha}{\sin \alpha}$  is equal to  
 (A)  $\frac{3}{7}$  (B)  $\frac{2}{5}$   
 (C)  $\frac{5}{2}$  (D)  $\frac{7}{3}$
8. If  $\cot^3 \alpha + \cot^2 \alpha + \cot \alpha = 1$  then  
 (A)  $\cos 2\alpha \cdot \tan \alpha = -1$  (B)  $\cos 2\alpha \cdot \tan \alpha = 1$   
 (C)  $\cos 2\alpha - \tan 2\alpha = 1$  (D)  $\cos 2\alpha - \tan 2\alpha = -1$

9. Column-I

Column-II

(A) The expression

$$[\cos^2 (\alpha + \beta) + \cos^2 (\alpha - \beta) - \cos 2\alpha \cos 2\beta], \text{ is}$$

(P) independent of  $\alpha$

(B) The expression

$$\cos^2 \alpha + \cos^2 (\alpha + \beta) - 2\cos \alpha \cdot \cos \beta \cdot \cos (\alpha + \beta), \text{ is}$$

(Q) independent of  $\beta$

(C) The expression  $\frac{\sin (\alpha - \beta) \sin (\alpha + \beta)}{1 - \tan^2 \alpha \cot^2 \beta}$ , is

(R) independent of  $\alpha$  and  $\beta$

(D) The expression

$$2\sin^2 \beta + 4\cos (\alpha + \beta) \sin \alpha \cdot \sin \beta + \cos 2(\alpha + \beta), \text{ is}$$

(S) dependent on  $\alpha$  and  $\beta$ .

10. Find the value of  $\log_{\sqrt{3}} ((4\cos^2 9^\circ - 1)(4\cos^2 27^\circ - 1)(4\cos^2 81^\circ - 1)(4\cos^2 243^\circ - 1))$ .

1. The expression  $\cot 9^\circ + \cot 27^\circ + \cot 63^\circ + \cot 81^\circ$  is equal to  
 (A)  $\sqrt{16}$  (B)  $\sqrt{64}$   
 (C)  $\sqrt{80}$  (D) none of these
2. The value of  $4\cos \frac{\pi}{10} - 3\sec \frac{\pi}{10} - 2\tan \frac{\pi}{10}$  is equal to  
 (A) 1 (B)  $\sqrt{5} - 1$   
 (C)  $\sqrt{5} + 1$  (D) zero
3. The value of the product  $\sin \left( \frac{\pi}{2^{2009}} \right) \cos \left( \frac{\pi}{2^{2009}} \right) \cos \left( \frac{\pi}{2^{2008}} \right) \cos \left( \frac{\pi}{2^{2007}} \right) \cos \left( \frac{\pi}{2^{2006}} \right) \cdots \cos \left( \frac{\pi}{2^3} \right) \cos \left( \frac{\pi}{2^2} \right)$ , is  
 (A)  $\frac{1}{2^{2007}}$  (B)  $\frac{1}{2^{2008}}$   
 (C)  $\frac{1}{2^{2009}}$  (D)  $\frac{1}{2^{2010}}$
4. In a triangle ABC, if  $4\cos A \cos B + \sin 2A + \sin 2B + \sin 2C = 4$ , then triangle ABC is  
 (A) right angle but not isosceles  
 (B) isosceles but not right angled  
 (C) right angle isosceles  
 (D) obtuse angled
5. The value of expression  $\frac{\cot 25^\circ + \cot 55^\circ}{\tan 25^\circ + \tan 55^\circ} + \frac{\cot 55^\circ + \cot 100^\circ}{\tan 55^\circ + \tan 100^\circ} + \frac{\cot 100^\circ + \cot 25^\circ}{\tan 100^\circ + \tan 25^\circ}$  is equal to  
 (A) 0 (B\*) 1 (C) 2 (D) 3
6. If A, B, C are the angles of a right angled triangle, then  $(\cos^2 A + \cos^2 B + \cos^2 C)$  equals  
 (A\*) 1 (B)  $2\cos^2 B$   
 (C)  $2(\cos^2 B + \cos^2 C)$  (D) 2
7. If  $A + B - C = 180^\circ$  and  $\sin^2 A + \sin^2 B - \sin^2 C = K \sin A \sin B \cos C$ , then the value of K is  
 (A) 1 (B) 2 (C) 3 (D) 4
8. If  $A + B + C = \pi$  and  $\sin \left( A + \frac{C}{2} \right) = 4 \sin \frac{C}{2}$ , then  $\tan \frac{A}{2} \tan \frac{B}{2}$  is equal to  
 (A)  $\frac{1}{3}$  (B)  $\frac{1}{2}$  (C)  $\frac{3}{5}$  (D)  $\frac{5}{3}$

(Mathematic)

COMPOUND ANGLE

9. Column-I contains a real number R and Column-II contains another real number r such that  $R^2 + r^2 = 1$ . Match the entries of column-I with their corresponding correct entries of column-II.

Column-I

Column-II

(A)  $\frac{\sqrt{3}+1}{2\sqrt{2}}$

(P)  $\frac{\sqrt{10+2\sqrt{5}}}{4}$

(B)  $\left(\frac{\sqrt{5}+1}{4}\right)$

(Q)  $\cos\left(\frac{3\pi}{8}\right)$

(C)  $\frac{\sqrt{2+\sqrt{2}}}{2}$

(R)  $\frac{\sqrt{6}-\sqrt{2}}{4}$

(D)  $\left(\frac{\sqrt{6-2\sqrt{5}}}{4}\right)$

(S)  $\frac{\sqrt{10-2\sqrt{5}}}{4}$

(T) none

10. The value of the product  $\cos 12^\circ \cot 14^\circ \cot 46^\circ \cos 48^\circ \cot 48^\circ \cos 72^\circ \cot 74^\circ \sin 162^\circ = \frac{m}{n}$  where m and n are coprime then find the value of  $(n - 12m)$ .

1. If the maximum value of the expression  $\frac{1}{5\sec^2 \theta - \tan^2 \theta + 4\operatorname{cosec}^2 \theta}$  is equal to  $\frac{p}{q}$  (where p and q are coprime), then the value of (p + q) is  
 (A) 14 (B) 15 (C) 16 (D) 18
2. If  $S = (\sin^2 \theta + \cos^4 \theta)$  for all  $\theta \in \mathbb{R}$ , then  
 (A)  $\frac{13}{16} \leq S \leq 1$  (B)  $1 \leq S \leq 2$  (C)  $\frac{3}{4} \leq S \leq \frac{13}{16}$  (D)  $\frac{3}{4} \leq S \leq 1$
3. Let  $f(\theta) = \sin^2 \theta + \cos^2 \theta + \tan^2 \theta + \sec^2 \theta + \operatorname{cosec}^2 \theta + \cot^2 \theta$ , then the minimum value of  $f(\theta)$  is  
 (A) 3 (B) 6 (C) 7 (D) not possible to determine
4. Let  $P(x) = \left( \frac{1 - \cos 2x + \sin 2x}{1 + \cos 2x + \sin 2x} \right)^2 + \left( \frac{1 + \cot x + \cot^2 x}{1 + \tan x + \tan^2 x} \right)$ , then the minimum value of  $P(x)$  equals  
 (A) 1 (B) 2 (C) 4 (D) 16
5. The maximum value of  $y = \log_2 \frac{(15 + 3\sin x + 4\cos x)}{(15 - 3\sin x - 4\cos x)}$  is  
 (A) 0 (B) 1 (C)  $\log_2 10$  (D)  $\log_2 3$
6. Let  $f(x) = 2\operatorname{cosec} 2x + \sec x + \operatorname{cosec} x$ , then the minimum value of  $f(x)$  for  $x \in \left(0, \frac{\pi}{2}\right)$  is  
 (A)  $\frac{1}{\sqrt{2}-1}$  (B)  $\frac{1}{\sqrt{2}+1}$  (C)  $\frac{2}{\sqrt{2}+1}$  (D)  $\frac{2}{\sqrt{2}-1}$
7. The greatest value of expression  $\log_{(26+8\sqrt{10})} (\cos^2 \theta - 6\sin \theta \cos \theta + 3\sin^2 \theta + 2)$  is  
 (A) 1 (B) 2 (C)  $\frac{1}{\sqrt{2}}$  (D)  $\frac{1}{2}$
8. If M and m are the maximum and minimum value of the expression  $\cos^2 x - \cos x + \frac{5}{4}$  for  $x \in \left[\frac{\pi}{2}, \frac{3\pi}{2}\right]$  then (m + M) equals  
 (A)  $\frac{9}{2}$  (B)  $\frac{13}{4}$  (C)  $\frac{17}{4}$  (D)  $\frac{15}{4}$
9. If m and M be the minimum and maximum value of  $f(x) = \cos \left(\frac{\pi}{10} + x\right) - \cos \left(\frac{\pi}{10} - x\right) - \cos \left(\frac{3\pi}{10} + x\right) + \cos \left(\frac{3\pi}{10} - x\right)$  then  
 (A)  $m^2 + M^2 = 2$  (B)  $M^2 - 2m^3 = 3$  (C)  $M^2 - 2m^2 = 0$  (D)  $2M - 3m = 5$
10. If the maximum and minimum value of  $(\sin x - \cos x - 1)(\sin x + \cos x - 1) \forall x \in \mathbb{R}$  is M and m then find value of (M - 4m).



SPECIAL DPP-6

1. The value of expression  $\sum_{\theta=0}^8 \frac{1}{1+\tan^3 (10\theta)^\circ}$  equals  
 (A) 5 (B)  $\frac{21}{4}$  (C)  $\frac{14}{3}$  (D)  $\frac{9}{2}$
2. The sum  $\frac{1}{\sin 45^\circ \sin 46^\circ} + \frac{1}{\sin 47^\circ \sin 48^\circ} + \frac{1}{\sin 49^\circ \sin 50^\circ} + \dots + \frac{1}{\sin 133^\circ \sin 134^\circ}$  is equal to  
 (A)  $\sec (1)^\circ$  (B)  $\operatorname{cosec} (1)^\circ$  (C)  $\cot (1)^\circ$  (D) none
3. If  $P = (\tan (3^{n+1}\theta) - \tan \theta)$  and  $Q = \sum_{r=0}^n \frac{\sin (3^r \theta)}{\cos (3^{r+1} \theta)}$ , then  
 (A)  $P = 2Q$  (B)  $P = 3Q$  (C)  $2P = Q$  (D)  $3P = Q$
4. The value of  $(\cos^4 1^\circ + \cos^4 2^\circ + \cos^4 3^\circ + \dots + \cos^4 179^\circ) - (\sin^4 1^\circ + \sin^4 2^\circ + \sin^4 3^\circ + \dots + \sin^4 179^\circ)$  equals  
 (A)  $2\cos 1^\circ$  (B)  $-1$  (C)  $2\sin 1^\circ$  (D) 0
5. If  $2(\sin 2^\circ \tan 1^\circ + \sin 4^\circ \tan 1^\circ + \dots + \sin 178^\circ \tan 1^\circ)$  equal to  $\lambda \tan 1^\circ$ , then  $\lambda$  is equal to  
 (A) 1 (B) 2 (C)  $2\cot 1^\circ$  (D)  $4\cot 1^\circ$
6.  $\sum_{k=1}^{88} (-1)^{k+1} \frac{1}{\sin^2 (k+1)^\circ - \sin^2 1^\circ}$  is equal to  
 (A)  $\tan 2^\circ$  (B)  $\cot 2^\circ$  (C)  $\frac{\sin 2^\circ}{\cot 2^\circ}$  (D)  $\frac{\cot 2^\circ}{\sin 2^\circ}$
7. The sum of the series  $S = \sin 206^\circ + \sin 208^\circ + \sin 210^\circ + \dots + \sin 1234^\circ$  is  
 (A) 515 (B)  $\operatorname{cosec} 1^\circ$  (C) 0 (D)  $\frac{1}{2}$
8. Let  $f_n(\theta) = \frac{\sum_{r=1}^n \cos (4r-3)\theta}{\sum_{r=1}^n \sin (4r-3)\theta}$ .  

|                                                                                                                                                                                                                                    |                                                                                                                                                                             |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>Column-I</b></p> <p>(A) <math>f_3\left(\frac{\pi}{40}\right)</math> is equal to</p> <p>(B) <math>f_5\left(\frac{5\pi}{108}\right)</math> is equal to</p> <p>(C) <math>f_7\left(\frac{\pi}{156}\right)</math> is equal to</p> | <p><b>Column-II</b></p> <p>(P) <math>\sqrt{2} - 1</math></p> <p>(Q) <math>\sqrt{2} + 1</math></p> <p>(R) <math>2 + \sqrt{3}</math></p> <p>(S) <math>2 - \sqrt{3}</math></p> |
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9. If  $x$  and  $y$  are non zero real numbers satisfying  $xy(x^2 - y^2) = x^2 + y^2$ , find the minimum value of  $x^2 + y^2$ .
10. If the sum of  $(n - 1)$  terms of the series  $\sin \frac{\pi}{n} + \sin \frac{2\pi}{n} + \sin \frac{3\pi}{n} + \dots$  is equal to  $2 + \sqrt{3}$ , then find the value of  $n$ .

EXERCISE-2

1. If  $X = \sin \left( \theta + \frac{7\pi}{12} \right) + \sin \left( \theta - \frac{\pi}{12} \right) + \sin \left( \theta + \frac{3\pi}{12} \right)$ ,  $Y = \cos \left( \theta + \frac{7\pi}{12} \right) + \cos \left( \theta - \frac{\pi}{12} \right) + \cos \left( \theta + \frac{3\pi}{12} \right)$  then prove that  $\frac{X}{Y} - \frac{Y}{X} = 2 \tan 2\theta$ .
2. If  $m \tan (\theta - 30^\circ) = n \tan (\theta + 120^\circ)$ , show that  $\cos 2\theta = \frac{m+n}{2(m-n)}$ .
3. If  $\tan (a + b) = \frac{7}{3}$  and  $\tan b = \frac{2}{3}$ , and  $a$  and  $b$  are acute, then  $\tan (b - a) = \frac{p}{q}$  where  $p, q \in \mathbb{N}$ , find the least value of  $\left( \frac{p+q}{20} \right)$ .
4. If  $\cos (\alpha + \beta) = \frac{4}{5}$ ;  $\sin (\alpha - \beta) = \frac{5}{13}$  &  $\alpha, \beta$  lie between  $0$  &  $\frac{\pi}{4}$ , then find the value of  $\tan 2\alpha$ .
5. Prove that  $\tan \theta \cdot \tan (60 - \theta) \cdot \tan (60 + \theta) = \tan 3\theta$  and hence find the value of  $\tan 5^\circ \tan 55^\circ \tan 65^\circ \tan 75^\circ$ .
6. (A) Prove that  $\tan 9^\circ - \tan 27^\circ - \tan 63^\circ + \tan 81^\circ = 4$ .  
 (B) Prove that  $\sin^4 \frac{\pi}{16} + \sin^4 \frac{3\pi}{16} + \sin^4 \frac{5\pi}{16} + \sin^4 \frac{7\pi}{16} = \frac{3}{2}$   
 (C) Prove that  $\cos^6 \left( \frac{\pi}{16} \right) + \cos^6 \left( \frac{3\pi}{16} \right) + \cos^6 \left( \frac{5\pi}{16} \right) + \cos^6 \left( \frac{7\pi}{16} \right) = \frac{5}{4}$   
 (D) Find the exact value of  $\tan^2 \frac{\pi}{16} + \tan^2 \frac{3\pi}{16} + \tan^2 \frac{5\pi}{16} + \tan^2 \frac{7\pi}{16}$ .
7. Given positive angles (in degree)  $A, B$  and  $C$  with  $A + B + C = 90^\circ$ .  
 Find the value of  $x$  if  $100 \tan A = 200 \tan B = 300 \tan C = x$ .
8. Let  $\alpha = 4 \sin^2 10^\circ + 4 \sin^2 50^\circ \cos 20^\circ + \cos 80^\circ$  and  $\beta = \cos^2 \frac{\pi}{5} + \cos^2 \frac{2\pi}{15} + \cos^2 \frac{8\pi}{15}$ .  
 Find  $(\alpha + \beta)$ .
9. If  $(4 \cos^2 40^\circ - 3)(3 - 4 \sin^2 40^\circ) = a + b \cos 20^\circ$  then find the value of  $(a - b)$
10. Let  $P(k) = \left( 1 + \cos \frac{\pi}{4k} \right) \left( 1 + \cos \frac{(2k-1)\pi}{4k} \right) \left( 1 + \cos \frac{(2k+1)\pi}{4k} \right) \left( 1 + \cos \frac{(4k-1)\pi}{4k} \right)$  then find the value of (a)  $P(5)$  and (b)  $P(6)$
11. (A) Calculate without using trigonometric tables:  $4 \cos 20^\circ - \sqrt{3} \cot 20^\circ$   
 (B) Calculate without using trigonometric tables:  $\tan 10^\circ - \tan 50^\circ + \tan 70^\circ$   
 (C) Calculate without using trigonometric tables:  $\frac{2 \cos 40^\circ - \cos 20^\circ}{\sin 20^\circ}$

(Mathematic)

COMPOUND ANGLE

12. If  $p \sec \theta + q \tan \theta = 1$  and  $p^2 \sec^2 \theta - q^2 \tan^2 \theta = 5$ , then find the value of  $(9p^{-2} - 4q^{-2})$ .
13. If  $A + B + C = \pi$ , prove that  $\sum \left( \frac{\tan A}{\tan B \cdot \tan C} \right) = \sum (\tan A) - 2 \sum (\cot A)$
14. (A) If  $y = 10 \cos^2 x - 6 \sin x \cos x + 2 \sin^2 x$ , then find the greatest & least value of  $y$ .  
 (B) If  $y = 1 + 2 \sin x + 3 \cos^2 x$ , find the maximum & minimum values of  $y \forall x \in \mathbb{R}$ .  
 (C) If  $y = 9 \sec^2 x + 16 \operatorname{cosec}^2 x$ , find the minimum value of  $y \forall x \in \mathbb{R}$ .  
 (D) Minimum value of  $8 \cos^2 x + 18 \sec^2 x \forall x \in \mathbb{R}$  wherever it is defined.
15. (A) If  $4 \sin x \cdot \cos y + 2 \sin x + 2 \cos y + 1 = 0$  where  $x, y \in [0, 2\pi]$  find the largest possible value of the sum  $(x + y)$   
 (B) If  $M$  and  $m$  denote maximum and minimum value of  $\sqrt{49 \cos^2 \theta + \sin^2 \theta} + \sqrt{49 \sin^2 \theta + \cos^2 \theta}$  then find the value of  $(M + m)$ .
16. If  $\tan \alpha = p/q$  where  $\alpha = 6\beta$ ,  $\alpha$  being an acute angle, prove that:  
 $\frac{1}{2}(p \operatorname{cosec} 2\beta - q \sec 2\beta) = \sqrt{p^2 + q^2}$ .
17. (i) If  $f(\theta) = \sum_{n=1}^6 \operatorname{cosec} \left( \theta + \frac{(n-1)\pi}{4} \right) \operatorname{cosec} \left( \theta + \frac{n\pi}{4} \right)$ , where  $0 < \theta < \frac{\pi}{2}$ , then find the minimum value of  $f(\theta)$ .  
 (ii) Let  $f_n(\theta) = \sum_{n=1}^n \tan \left( \frac{\theta}{2^n} \right) \sec \left( \frac{\theta}{2^{n-1}} \right)$ , then compute the value of  $f_4 \left( \frac{4\pi}{3} \right)$ .
18. If  $C = \sum_{k=1}^{35} \cos (5k)^\circ$  and  $S = \sum_{k=1}^{36} \sin (10k)^\circ$  then find  $(C^2 + S^2)$
19. Given that  $3 \sin x + 4 \cos x = 5$  where  $x \in (0, \pi/2)$ . Find the value of  $2 \sin x + \cos x + 4 \tan x$
20. If ' $\theta$ ' is eliminated from the equations  $\cos \theta - \sin \theta = b$  and  $\cos 3\theta + \sin 3\theta = a$ , find the eliminant.

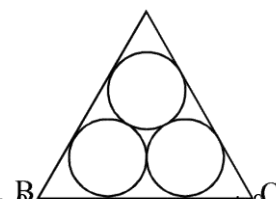
EXERCISE-3

SECTION-A

(JEE-ADVANCE Previous Year's Questions)

1. In an equilateral triangle, 3 coins of radii 1 unit each are kept so that they touch each other and also the sides of the triangle. Area of the triangle is [JEE 2005 (Screening)]

- (A)  $4 + 2\sqrt{3}$  (B)  $6 + 4\sqrt{3}$   
(C)  $12 + \frac{7\sqrt{3}}{4}$  (D)  $3 + \frac{7\sqrt{3}}{4}$



2. Let  $\theta \in (0, \pi/4)$  and  $t_1 = (\tan \theta)^{\tan \theta}$ ,  $t_2 = (\tan \theta)^{\cot \theta}$ ,  $t_3 = (\cot \theta)^{\tan \theta}$ ,  $t_4 = (\cot \theta)^{\cot \theta}$ , then [JEE 2006, 3]

- (A)  $t_1 > t_2 > t_3 > t_4$  (B)  $t_4 > t_3 > t_1 > t_2$   
(C)  $t_3 > t_1 > t_2 > t_4$  (D)  $t_2 > t_3 > t_1 > t_4$

3. If  $\frac{\sin^4 x}{2} + \frac{\cos^4 x}{3} = \frac{1}{5}$ , then [JEE 2009, 4]

- (A)  $\tan^2 x = \frac{2}{3}$  (B)  $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{1}{125}$   
(C)  $\tan^2 x = \frac{1}{3}$  (D)  $\frac{\sin^8 x}{8} + \frac{\cos^8 x}{27} = \frac{2}{125}$

4. For  $0 < \theta < \frac{\pi}{2}$ , the solution(s) of  $\sum_{m=1}^6 \operatorname{cosec} \left( \theta + \frac{(m-1)\pi}{4} \right) \operatorname{cosec} \left( \theta + \frac{m\pi}{4} \right) = 4\sqrt{2}$  is (are) [JEE 2009, 4]
- (A)  $\frac{\pi}{4}$  (B)  $\frac{\pi}{6}$  (C)  $\frac{\pi}{12}$  (D)  $\frac{5\pi}{12}$

5. The maximum value of the expression  $\frac{1}{\sin^2 \theta + 3 \sin \theta \cos \theta + 5 \cos^2 \theta}$  is [JEE 2010, 3]

6. Two parallel chords of a circle of radius 2 are at a distance  $\sqrt{3} + 1$  apart. If the chords subtend at the center, angles of  $\frac{\pi}{k}$  and  $\frac{2\pi}{k}$  where  $k > 0$ , then the value of  $[k]$  is [JEE 2010, 3]
- [Note :  $[k]$  denotes the largest integer less than or equal to  $k$ ]

7. The positive integer value of  $n > 3$  satisfying the equation  $\frac{1}{\sin \frac{\pi}{n}} = \frac{1}{\sin \frac{2\pi}{n}} + \frac{1}{\sin \frac{3\pi}{n}}$  is [JEE 2011, 4]

8. The value of  $\sum_{k=1}^{13} \frac{1}{\sin \left( \frac{\pi}{4} + \frac{(k-1)\pi}{6} \right) \sin \left( \frac{\pi}{4} + \frac{k\pi}{6} \right)}$  is equal to [JEE (Advanced) 2016, 3]

- (A)  $3 - \sqrt{3}$  (B)  $2(3 - \sqrt{3})$  (C)  $2(\sqrt{3} - 1)$  (D)  $2(2 + \sqrt{3})$

(JEE-MAIN Previous Year's Questions)

1. In a  $\triangle PQR$ , if  $3\sin P + 4\cos Q = 6$  and  $4\sin Q + 3\cos P = 1$ , then the angle R is equal to  
 (A)  $\frac{\pi}{4}$  (B)  $\frac{3\pi}{4}$  (C)  $\frac{5\pi}{6}$  (D)  $\frac{\pi}{6}$  [AIEEE-2012]
2. The expression  $\frac{\tan A}{1-\cot A} + \frac{\cot A}{1-\tan A}$  can be written as [JEE Main 2013]  
 (A)  $\sec A \operatorname{cosec} A + 1$  (B)  $\tan A + \cot A$   
 (C)  $\sec A + \operatorname{cosec} A$  (D)  $\sin A \cos A + 1$
3. Let  $f_k(x) = \frac{1}{k}(\sin^k x + \cos^k x)$  where  $x \in \mathbb{R}$  and  $k \geq 1$ . Then  $f_4(x) - f_6(x)$  equals [JEE Main 2014]  
 (A)  $\frac{1}{12}$  (B)  $\frac{1}{6}$  (C)  $\frac{1}{3}$  (D)  $\frac{1}{4}$

EXERCISE-4

(Potential Problems Based on CBSE)

1. If in two circles, arcs of the same length subtend angle  $60^\circ$  and  $75^\circ$  at the centre, find the ratio of their radii.
2. Find the values of the trigonometric functions  
(i)  $\sin 765^\circ$  (ii)  $\operatorname{cosec}(-1410^\circ)$  (iii)  $\tan \frac{19\pi}{3}$  (iv)  $\sin\left(-\frac{11\pi}{3}\right)$  (v)  $\cot\left(-\frac{15\pi}{4}\right)$
3. Prove that  
(i)  $\sin^2 \frac{\pi}{6} + \cos^2 \frac{\pi}{3} - \tan^2 \frac{\pi}{4} = -\frac{1}{2}$   
(ii)  $2\sin^2 \frac{3\pi}{4} + 2\cos^2 \frac{\pi}{4} + 2\sec^2 \frac{\pi}{3} = 10$   
(iii)  $\sin^2 6^\circ + \sin^2 12^\circ + \sin^2 18^\circ \dots \dots + \sin^2 84^\circ + \sin^2 90^\circ = 8$
4. Prove that  $\frac{\tan\left(\frac{\pi}{4}+x\right)}{\tan\left(\frac{\pi}{4}-x\right)} = \left(\frac{1+\tan x}{1-\tan x}\right)^2$
5. Prove that :  
(i)  $\cos\left(\frac{3\pi}{2}+x\right)\cos(2\pi+x)\left[\cot\left(\frac{3\pi}{2}-x\right)+\cot(2\pi+x)\right]=1$   
(ii)  $\sin(n+1)x\sin(n+2)x+\cos(n+1)x\cos(n+2)x=\cos x$
6. Prove that  $\cos^2 2x - \cos^2 6x = \sin 4x\sin 8x$
7. Prove that :  
(i)  $\frac{\sin 5x+\sin 3x}{\cos 5x+\cos 3x} = \tan 4x$   
(ii)  $\frac{\sin x-\sin 3x}{\sin^2 x-\cos^2 x} = 2\sin x,$   
(iii)  $\frac{\cos 4x+\cos 3x+\cos 2x}{\sin 4x+\sin 3x+\sin 2x} = \cot 3x$
8. Prove that  $\sin x + \sin 3x + \sin 5x + \sin 7x = 4\cos x\cos 2x\sin 4x$
9. Prove that  $\sin 3x + \sin 2x - \sin x = 4\sin x\cos \frac{x}{2}\cos \frac{3x}{2}$
10. If  $A+B=45^\circ$ , show that  $(\cot A-1)(\cot B-1)=2$
11. If  $\sin \alpha - \sin \beta = \frac{1}{3}$  and  $\cos \beta - \cos \alpha = \frac{1}{2}$ , show that  $\cot \frac{\alpha+\beta}{2} = \frac{2}{3}$

12. Prove that :

$$(i) \cos 10^\circ \cos 30^\circ \cos 50^\circ \cos 70^\circ = \frac{3}{16}$$

$$(ii) \cos 36^\circ \cos 72^\circ \cos 108^\circ \cos 144^\circ = \frac{1}{16}$$

13. Prove that  $\left(1 + \cos \frac{\pi}{8}\right) \left(1 + \cos \frac{3\pi}{8}\right) \left(1 + \cos \frac{5\pi}{8}\right) \left(1 + \cos \frac{7\pi}{8}\right) = \frac{1}{8}$

14. If  $\cos \alpha + \cos \beta = \frac{1}{3}$  and  $\sin \alpha + \sin \beta = \frac{1}{4}$ , prove that  $\cos \frac{\alpha - \beta}{2} = \pm \frac{5}{24}$ .

15. If  $A + B + C = \frac{\pi}{2}$ , show that

$$(i) \cot A + \cot B + \cot C = \cot A \cot B \cot C$$

$$(ii) \tan A \tan B + \tan B \tan C + \tan C \tan A = 1$$

EXERCISE-5 (Rank Booster)

1. Let the exact value of  $\cos \frac{\pi}{7} + \cos^2 \frac{\pi}{7} - 2\cos^3 \frac{\pi}{7}$  is a rational number in the form  $\frac{p}{q}$ , where p and q are integers. Find (p + q)
2. If  $\alpha = \frac{\pi}{7}$  then find the value of  $\left(\frac{1}{\cos \alpha} + \frac{2\cos \alpha}{\cos 2\alpha}\right)$ .
3. Given that for a, b, c, d  $\in \mathbb{R}$ , if  $a \sec (200^\circ) - c \tan (200^\circ) = d$  and  $b \sec (200^\circ) + d \tan (200^\circ) = c$ , then find the value of  $\left(\frac{a^2+b^2+c^2+d^2}{bd-ac}\right) \sin 20^\circ$ .
4. In a right angled triangle, acute angles A and B satisfy  $\tan A + \tan B + \tan^2 A + \tan^2 B + \tan^3 A + \tan^3 B = 70$  find the angle A and B in radians.
5. Consider  $3\sin \beta = \sin (2\alpha + \beta)$ . Let K be the value of  $\frac{\tan (\alpha+\beta)}{\tan \alpha}$  and W be the value of the product  $(\cot \alpha + \cot (\alpha + \beta)) \cdot (\cot \beta - 3\cot (2\alpha + \beta))$ . Find the value of KW.
6. For  $A \in \left(0, \frac{\pi}{4}\right)$ , if  $\left(1 + \frac{\cos 3A}{\cos A}\right) + \left(1 + \frac{\cos 6A}{\cos 2A}\right) + \left(1 + \frac{\cos 9A}{\cos 3A}\right) + \left(1 + \frac{\cos 12A}{\cos 4A}\right) = 0$ , then find the value of  $(\csc A - \sec 2A)$
7. Let  $A_1, A_2, A_3 \dots \dots A_n$  are the vertices of a regular n sided polygon inscribed in a circle of radius R. If  $(A_1A_2)^2 + (A_1A_3)^2 + \dots \dots + (A_1A_n)^2 = 14R^2$ , find the number of sides in the polygon.
8. If  $(1 + \sin t)(1 + \cos t) = \frac{5}{4}$ . Find the value of  $(1 - \sin t)(1 - \cos t)$
9. Let  $k = 1^\circ$ , then prove that  $\sum_{n=0}^{88} \frac{1}{\cos nk \cdot \cos (n+1)k} = \frac{\cos k}{\sin^2 k}$
10. 

| Column-I                                                                                                                 | Column-II |
|--------------------------------------------------------------------------------------------------------------------------|-----------|
| (A) Given that $(1 + \tan 1^\circ)(1 + \tan 2^\circ) \dots (1 + \tan 45^\circ) = 2^n$ , then the value of n, is equal to | (P) 19    |
| (B) If the product $(\sin 1^\circ)(\sin 3^\circ)(\sin 5^\circ)(\sin 7^\circ) \dots (\sin 89^\circ) = \frac{1}{2^n}$      | (Q) 23    |
| then the value of [n], is equal to [where [y] denotes greatest integer less than or equal to y]                          |           |
| (C) If $\prod_{k=1}^{29} (\sqrt{3} + \tan K^\circ) = 2^k$ where $k \in \mathbb{N}$ , then the value of k, is equal to    | (R) 29    |
| (D) If the value of $\sum_{r=1}^{23} \cos^4 \frac{r\pi}{48} = \frac{m}{n}$ where m and n are in their lowest form,       | (S) 37    |
| then the value of (m + n), is equal to                                                                                   | (T) 44    |



ANSWER KEY

SPECIAL DPP-1

1. (B) 2. (A) 3. (B) 4. (C) 5. (A) 6. (D) 7. (C)  
8. (A) 9. (A) 10. (B) 11. (C, D)

SPECIAL DPP-2

1. (A) 2. (C) 3. (A) 4. (D) 5. (C)

SPECIAL DPP-3

1. (C) 2. (C) 3. (B) 5. (D) 6. (A) 7. (D) 8. (A, C)  
9. (A) P, Q, R; (B) P; (C) S; (D) Q 10. (0)

SPECIAL DPP-4

1. (C) 2. (D) 3. (B) 4. (C) 5. (B) 6. (A) 7. (B)  
8. (C) 9. (A) R; (B) S; (C) Q; (D) P 10. (4)

SPECIAL DPP-5

1. (D) 2. (D) 3. (C) 4. (B) 5. (B) 6. (D) 7. (D)  
8. (A) 9. (A, B, D) 10. (0006)

SPECIAL DPP-6

1. (A) 2. (B) 3. (A) 4. (B) 5. (C) 6. (D) 7. (C)  
8. (A) Q; (B) S; (C) R 9. (4) 10. (6)

EXERCISE-2

3. (5) 4.  $\frac{56}{33}$  5. (1) 6. (A)  $4(B)^{\frac{3}{2}}(C)^{\frac{5}{4}}(D) 28$  7. (100)  
8. (4) 9. (3) 10. (a)  $\frac{3-\sqrt{5}}{32}$ ; (b)  $\frac{2-\sqrt{3}}{16}$  11. (A) -1 (B)  $\sqrt{3}$  (C)  $\sqrt{3}$   
12. 0001 13. 7 14. (A) 1 (B) -1 (C) 49 (D) 26 15. (A)  $\frac{23\pi}{6}$  (B) 18  
16.  $\sqrt{p^2 + q^2}$  17. (i)  $2\sqrt{2}$  (ii)  $2(\sqrt{3} - 1)$   
18.  $C = 0, S = 0 \Rightarrow C^2 + S^2 = 0$  19. (5) 20.  $a = 3b - 2b^3$

EXERCISE-3

SECTION-A

(JEE-ADVANCE Previous Year's Questions)

1. (B) 2. (B) 3. (A, B) 4. (C, D) 5. (2) 6.  $k = 3$  7. (7)  
8. (C)

SECTION-B

(JEE-MAIN Previous Year's Questions)

1. (D) 2. (A) 3. (A)

EXERCISE-4

(Potential Problems Based on CBSE)

1. 5:4 2. (i)  $\frac{1}{\sqrt{2}}$  (ii) 2 (iii)  $\sqrt{3}$  (iv)  $\frac{\sqrt{3}}{2}$  (v) 1

EXERCISE-5 (Rank Booster)

1. (5) 2. (4) 3. (2) 4.  $\frac{\pi}{12}$  and  $\frac{5\pi}{12}$  5. (12) 6. (2)  
7. (7) 8.  $\frac{13}{4} - \sqrt{10}$  10. (A) Q; (B) T; (C) R; (D) P